Punyashlok Ahilyadevi Holkar Solapur University, Solpaur

Skill Development Centre

Certificate Course in Bioinformatics

Course objectives

- To increase the understanding of biological processes.
- To develop and apply computationally intensive techniques
- To give technical and biological aspects of Bioinformatics and its possible use in allied science areas.

Learning outcomes:

- Students will be able to learn the background of bioinformatics.
- Students will be able to get knowledge of biological databases.
- Students will be able to retrieve information from nucleic acid and protein sequences.
- Students will be able to predict the structure of proteins from their sequence.

Curriculum of certificate course in Bioinformatics

Name of the course	**Certificate Course in Bioinformatics**
Duration of the course	**6 Months**
Eligibility	**Appeared B.Sc. III (Life Sciences)**

Number of thery paper	**3**
Number of practical	**1**
Examination Pattern	**Annual**
Theory Paper	**80 marks for University Examination(UA) And 20 Marks for College Assessment (CA)**
Practical	**100 Marks (Annual)**

Minimum Passing Marks
University Examination(UA)80 Marks= 32 Marks minimum passing
College Assessment (CA) 20 Marks = 8 Marks minimum passing
Practical 100 Marks = 40 Marks minimum passing

Sr. No.	Heads	Total Marks
	Theory	
1	**Paper – I Basic Bioinformatics** **45 Lectures (03 Credits)**	**100** **(80+20)**
2	**Paper – II Cell Biology and Genetics** **45 Lectures (03 Credits)**	**100** **(80+20)**
3	**Paper – III Advanced bioinformatics** **45 Lectures (03 Credits)**	**100** **(80+20)**
	Practical	
1	**Paper – IV Bioinformatics Practicals** **45 Lectures (03 Credits)**	**100**
Total		**400**

Paper – I Basic Bioinformatics **45 Lectures (03 Credits)**

Unit- I

Introduction of Bioinformatics **(15 L)**

a) Concept of Bioinformatics
b) History of Bioinformatics
c) Branches of Bioinformatics
d) Scope and applications of Bioinformatics
e) Introduction to the Internet and its role in bioinformatics

Unit -II **(15 L)**

Introduction to major bioinformatics resources on the Internet

a) Introduction to National Centre for Biotechnology Information (NCBI)
b) Various resources of NCBI
c) Introduction of DNA Data Bank of Japan (DDBJ)
d) Introduction to European Molecular Biology Laboratory (EMBL)
e) Various resources of DDBJ and EMBL

Unit- III **(15 L)**

Introduction of Bioinformatics Databases and tools

a) Concept of Biological databases
b) Types of databases
c) Introduction to Protein data bank (PDB)
d) Introduction to Nucleic acid sequence database (GenBank)
e) NCBI Search engine – Entrez
f) The Basic Local Alignment Search Tool (BLAST)

Paper – II Cell Biology and Genetics **45 Lectures (03 Credits)**

Unit- I Basics of cell biology **(15 L)**

a) Cells as a unit of life
b) Structure of prokaryotic and eukaryotic cells
c) Cellular membrane: structure, transport, channels, carriers, receptors, endocytosis, membrane potentials.
d) An overview of organelles (Mitochondria, chloroplasts, ER, Golgi, ribosomes, lysosomes and peroxysomes, nucleus and nucleolus).
e) Differences and similarities in the plant, animal, and microbial cells
f) Cell cycle

Unit- II Molecular Biology **(15 L)**

a) Replication:-Mechanism of DNA replication in prokaryotes (D-loop and rolling circle mode of replication) and eukaryotes, DNA proofreading
b) Transcription: features of promoters and enhancers, transcription factors, mechanism of transcription in prokaryotes and eukaryotes, inhibitors, post-transcriptional modification.
c) Translation: initiation factors, mechanism of translation in prokaryotes and eukaryotes. Elucidation of genetic code, posttranslational modifications.
d) Nomenclature and code letters of DNA and protein sequences

Unit- III Regulation of gene expression **(15 L)**

a) Gene expression in prokaryotes and eukaryotes
b) Lactose and tryptophan operons.
c) Mutation and DNA repair
d) Types of mutation, mutagens, site-directed mutagenesis, transposons in mutation,
e) Repair mechanisms- photoreactivation repair, Base excision repair (BER), Nucleotide excision repair (NER), Mismatch repair (MMR), and SOS repair

Paper – III Advanced bioinformatics **45 Lectures (03 Credits)**

Unit- I Bioinformatics Databases **(15 L)**

a) Nucleic acid sequence databases: GenBank, EMBL, DDBJ
b) Primary Protein sequence databases:- PIR, MIPS, Swiss – PROT, TrEMBL
c) Composite Protein sequence databases: - NRDB
d) Secondary Protein databases: - PROSITE
e) Structure classification databases: - SCOP
f) Genomic database – Ensembl; Bibliographic databases – PubMed, PubMed Central, NCBI Bookshelf.

Unit III: Sequence Analysis and Tools:- **(15 L)**

a) Global and Local alignments; Pairwise alignments – method, algorithm, scoring matrices, tools (e.g. BLAST and FASTA), and applications;
b) Multiple alignments – consensus sequence, methods, tools (e.g. Clustal W), and applications.
c) Phylogenetic analysis: Elements of phylogeny, methods of phylogenetic analysis

Unit IV: Protein and Gene Structure Prediction:- **(15 L)**

a) Physicochemical property prediction from primary protein sequence,
b) Secondary and tertiary structure prediction from protein sequence.
c) Prokaryotic and eukaryotic gene prediction.
d) Fundamentals of X-ray diffraction, NMR spectroscopy of macromolecules, Protein Structure: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot

Paper – IV Bioinformatics Practicals **45 Lectures (03 Credits)**

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1. Introduction to Genome Information resources- EMBL,
2. Introduction to Genome Information resources DDBJ,
3. Introduction to Genome Information resources GENBANK
4. Retrieving protein and nucleic acid sequences from databases
5. Introduction to Protein Information resources- PIR, SWISS-PROT
6. Assignment on Single and multiple Sequence alignment using BLAST
7. Assignment on Single and multiple Sequence alignment using Clustal and Clustal W
8. Studying protein 3D structure using RASMOL
9. Phylogenetic analysis using Omega, and online tools.
10. Structure of database entry and file format Genbank, PIR, and FASTA.
11. Search engines: Entrez.
12. Dynamic programming algorithm using the online tool

References:-

1) Bergeron, B. (2003) Bioinformatics Computing, Prentice-Hall of IndiaPrivate Limited, NewDelhi

2) Baxevanis, A. D. and Ouellette, B. F. F. (2001) Bioinformatics: A practical guide to theanalysis of genes and proteins. Second Edition. John Wiley & Sons, New York.

3) Jean-Michel Slaveries and C.Notredame (2003) Bioinformatics: A Beginner's Guide WileyDreamtech India (P) Ltd., New Delhi

4) Khan,I. A.(2005) Elementary Bioinformatics, Pharma BookSyndicate, Hyderabad

5) Lacroix, Z. and Critchlow, T. (Eds.) 2003. Bioinformatics. ManagingScientific Data. Morgan Kaufmann Publishers.

6) Mount, D. W. (2001) Bioinformatics: sequence and genome analysis.Cold Spring Harbor Laboratory Press, New York.

7) Narayanan, P. (2005) Bioinformatics a Primer, New Age International(P) Limited, Publishers, New Delhi – 110 002

8) Westhead, D. R., J. H. Parish and R. M. Twyman (2003) Bioinformatics (InstantNotes Series), Viva Books Private Limited, New Delhi, Mumbai, Chennai, Kolkata

9) Zoe L. and Terence C. (2004) Bioinformatics: Managing ScientificData, MorganKaufmannPublishers, New Delhi